

Introduction to Environmental Engineering. Developed by prof. Dr. D. Antonio Aznar (Chemical Engineering), Dr. Juan Carlos Cabanelas and Dr. Berta Herrero. Materials Science and Engineering and Chemical Engineering Department. University Carlos III de Madrid.



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WHAT IS ENVIRONMENT?



WHAT IS ENVIRONMENT?

The answer to the question ¿**what is environment?** is not immediate. Environment is usually found as a synonym for "natural".

Probably if we asked people around, the answer would not be uniform. In many instances they would not even try to give a definition. Environment is a much used word whose meaning is not so clear.

Objective: make sure environment is not confuse with "nature".



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Probably everybody would agree that these images belong to the environment. The forest surrounding the lake, and even the lake, the landscape of mountains covered by snow and even the strength, sometimes destructive, of the volcano and, of course the flamingos flying over the Titicaca lake 4000 m high would be accepted as environment.

Images:

- a) Cotacachi volcano
- b) Cayambe mountain, 5790 m high
- c) Rinjani volcano
- d) Titicaca lake, 4000 m high



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On the contrary, these images would not be considered environment: a large megalopolis (México DC), with its persistent pollution cloud, an industrial factory emitting tons of greenhouse effect gases, any of the infinite garbage dumps surrounding our cities (incidentally an ecosystem for sea gulls), or a forests destroyed by acidic rain in northern Europe.

Tip: “unpleasant” landscapes, man built facilities can also be environment.



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WHAT IS ENVIRONMENT?



Environment is the aggregate of physical, chemical, biological and social components capable of causing direct or indirect effects, in the short or long term, on living beings and human activities.

(from United Nations Conference on Environment, 1972)

All the images before belong to the environment, according to the definition derived from the United Nations Conference on Environment held in Stockholm, Sweden, in 1972:

“Environment is the ensemble of physical, chemical, biological and social components capable of causing direct or indirect effects, in the short or long term, on living beings and human activities.”

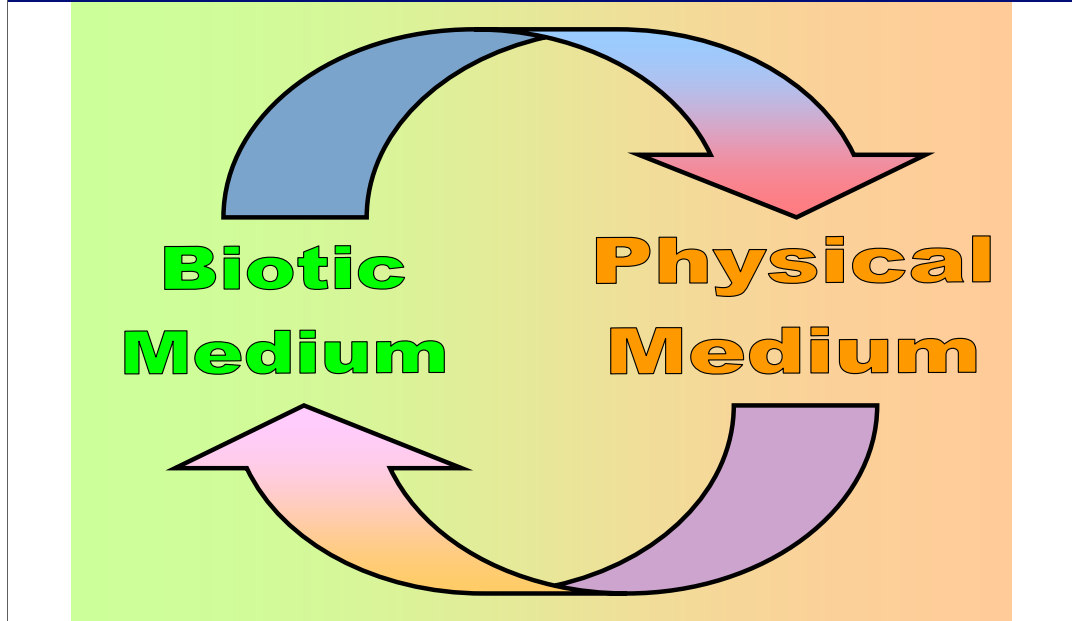
Geographically, *environment* can refer to:

- a limited area or
- the whole planet (including the atmosphere).

Some ideas derived from the definition:

- Environment is not a series of separate “things”: it is also their aggregation
- Social components should not be excluded
- Indirect effects are very often overseen
- The idea of human activities belonging to environment is contrary to common beliefs about it.

Tip: traffic congestion, crime, etc can be considered, broadly speaking, environmental problems.



The environment comprises all living beings (biotic medium) which evolve on a territory (physical medium). But it is not only animals, plants, rocks, atmosphere and the remaining components of both media, also all the interactions among them.

These interactions cause changes in both media, so that:

- the biotic medium acts on the physical medium, and
- the physical medium produces modifications to the biotic medium.



Modifications of the physical medium caused by living organisms can be as immense as the coral reefs that conform the Great Coral Reef in the Pacific Australian Coast, an assembly of living creatures of such a magnitude that it can be easily observed from space. Environmental modifications that are not so striking but equally important, are the effects that the vegetal cover causes by altering soil erosion, both by avoiding it –in case of the erosion of slopes (landfills) caused by deforestation- or by favouring it –as in rock fragmentation produced by roots-. It is also remarkable how the construction of dens and burrows such like beavers dams modifies both the landscape as the hydrological equilibrium of extended areas.

Translation:

Burrows: madrigueras

Dens (guaridas; too caves)

Beavers: castores



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The physical medium conditions and modifies absolutely the biotic medium. The outcrop of a small quantity of water may cause that a medium as seemingly sterile as a desert of sand dunes, becomes transformed into the luxurious vegetation of an oasis where a large number of vegetal species, animals and even men live.

The physical medium has such a dramatic influence on living being that is one of the driving forces of species evolution, achieving the adaptation to the medium through mimetism, for instance. But it does not only modify species as a group, but also each individual is adapted to its physical environment (trees bent by wind in El Hierro island).

Outcrop: afloramiento



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Environment conditions and influences the life of human beings and their interactions with environment.

Tip: observe the striking similarities between communities that are far away but share features common with their medium (girls from Tibet and from Ecuador).



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ENVIRONMENT?



Environment World Heritage

Due to the importance of environment for men, it cannot be “owned” by particular people or groups: it has been declared world heritage.



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WHAT IS POLLUTION?



We refer unanimously to pollution when we see a highly degraded river bed, a garbage dump, or any other place where waste accumulation is obvious.

Do we know exactly what pollution is?

Objective: avoid common misconceptions!



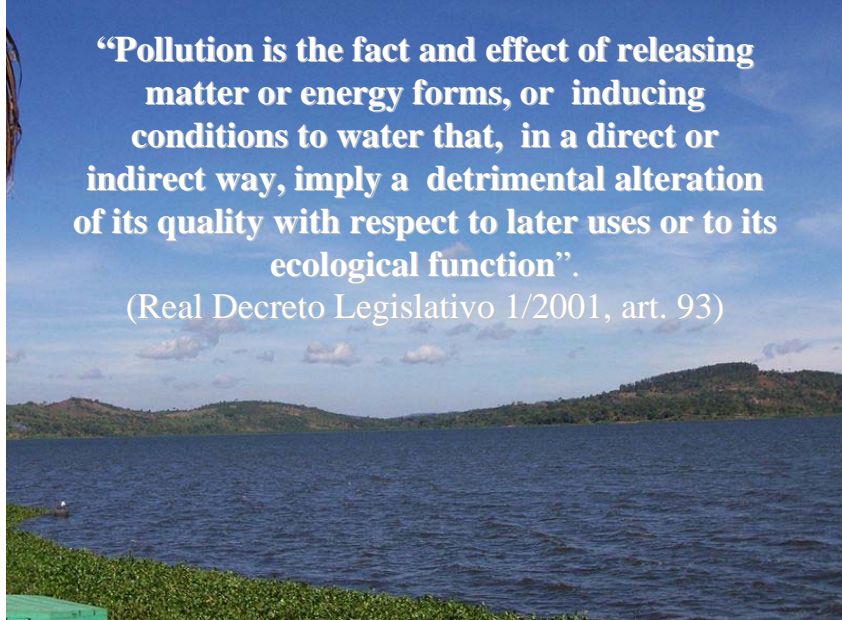
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WHAT IS POLLUTION?



“Pollution is the fact and effect of releasing matter or energy forms, or inducing conditions to water that, in a direct or indirect way, imply a detrimental alteration of its quality with respect to later uses or to its ecological function”.

(Real Decreto Legislativo 1/2001, art. 93)



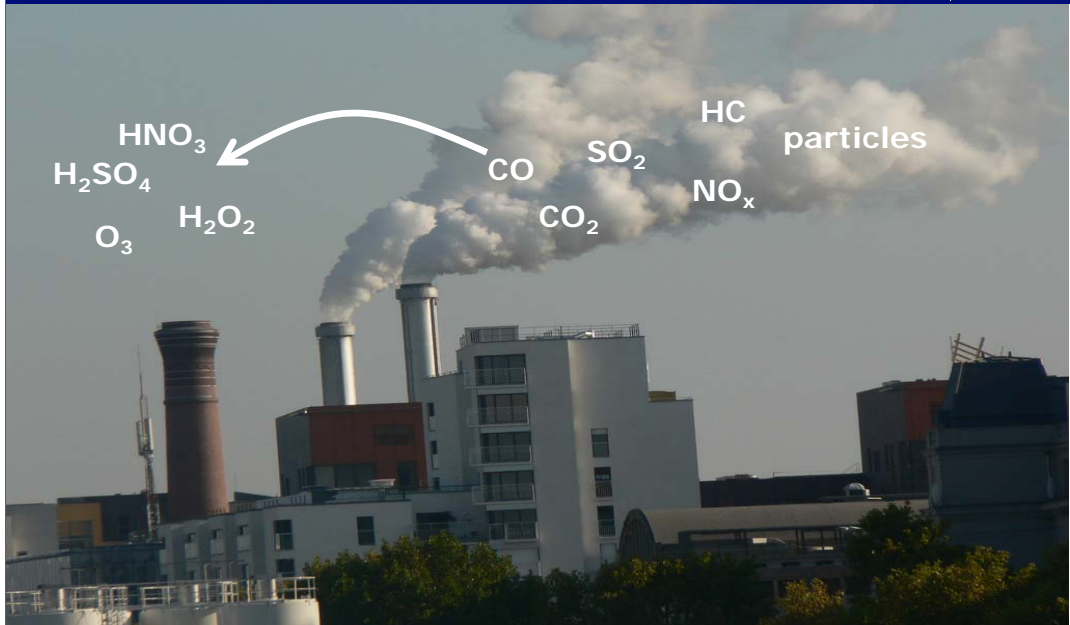
However, the vision of this image of the Victoria lake, would not provoke the same opinion. Moreover, many people would suggest the possibility of a pleasant bath in its waters, without knowing that it has the disputable merit of being amongst the most polluted lakes in the world, and that its waters are responsible of a large number of endemic deceases in the area.

An official definition of pollution (Spain, Real Decreto Legislativo 1/2001, art. 93):
“Pollution is the fact and effect of releasing matter or energy forms, or inducing conditions to water that, in a direct or indirect way, imply a detrimental alteration of its quality with respect to later uses or to its ecological function”

From the UN 1972 Conference, Principle 6:

“The discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems. The just struggle of the peoples of ill countries against pollution should be supported.”

Important: pollution is not an absolute term. A medium is polluted medium depending on the use we will make of the medium.



Pollution can be classified following different criteria. Pollution types will be studied along the course. As an overview:

- According the medium in which it occurs: air (or atmospheric) pollution, water and soil pollution.
- Depending on who/what produced pollution (the source). Antropic pollution refers to pollution caused by man, while natural pollution refers to pollution that has occurred naturally, i.e. originated by “nature”. Note that the term “natural pollution” indicates a non antropic source, not a “natural” substance.
- Depending on the location of the source: emissions can be due to mobile or stationary sources (point source).
- Depending on the chemical transformations of the pollutants. If pollutants are emitted directly by a source, they are called “primary pollutants”, if they arise from the transformation of primary pollutants into other substances, they are usually called secondary “pollutants”.

For instance, by air (atmospheric) pollution we refer to all kind of substances (gases, particles, etc.) from both natural sources and antropic origin, that modify the physical, chemical and energetic equilibrium of the atmosphere.

Antropic: caused or produced by man



We have given before the definition of water pollution. It can also be natural or antropic, and just as with atmospheric pollution it is immersed in a series of general processes that are usually called “geochemical cycles” that in the case of water produce the “HYDROLOGICAL CYCLE” that has the effect that any polluting action, no matter how localized it is, has short, medium or long term effects in any other point of the planet.



Soil, as one of the main constituent of environment, is also subject to alteration processes due to the action of some substances and actions that cause its degradation. This has led, just as with the pollution of the remainder media, to the development of a series of technologies that are directed towards removal of these perturbations, so that the potential of degraded soils is recovered until the levels that existed before the polluting action are recovered.

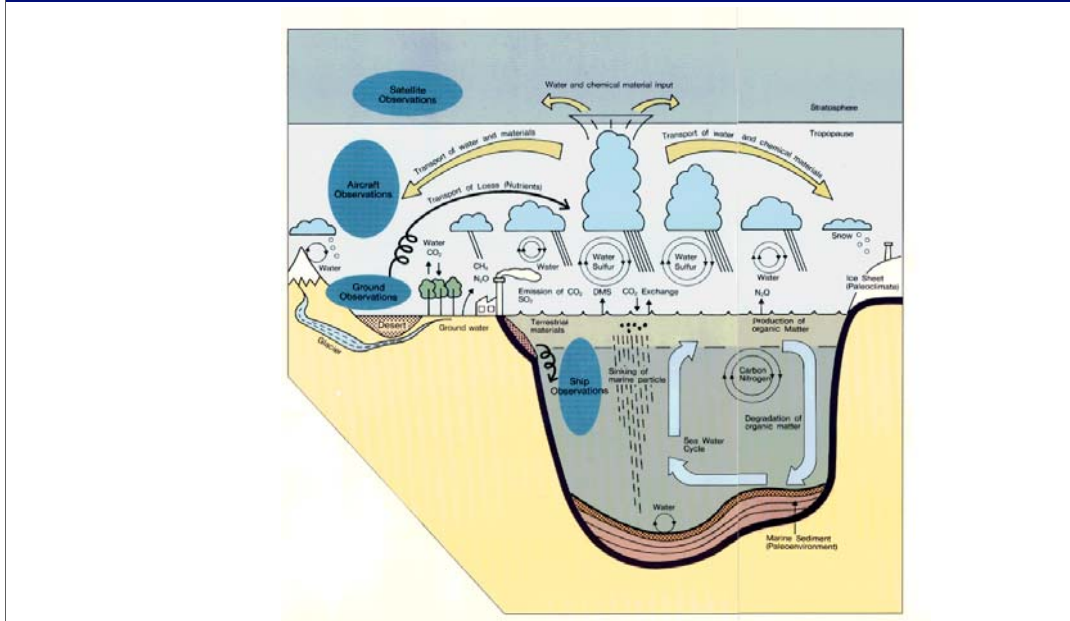


Other pollution types



Some other types of pollution are seldom taken into account, but modify environment even more deeply than pollution types mentioned previously:

- Acoustic pollution, ubiquitous in large urban developments, that is only addressed when it bothers directly the area population.
- Light pollution, perturbing to a large extent the life of many species (turtles, birds, etc.)
- Visual pollution, modifying the landscape (for instance mining activities).
- Large human agglomerations, disturbing out intimacy.



All these types of contamination, and those other types that, though less evident, also modify the environment, cannot be considered in an isolated way. They are integrated in a series of interrelations that have the effect of transmitting the modifying effects from one medium to the other, in some cases by well known mechanisms, but in many others through unknown paths and whose consequences we are not in a condition to evaluate.

This has led to some measures against pollution that take into account its global effect without focusing in a particular medium, but instead addressing possible transferences and crossed effects. The reference legislation is the European Union directive on “Integrated Pollution Prevention and Control” (IPPC), translated by Spain through the Ley 16/2002.

“Integrated Pollution Prevention and Control”: “Prevención y Control Integrado de la Contaminación” (IPPC).